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"ANOMALIES OF GALL BLADDER AND CYSTIC DUCT"

KEYWORDS

Cystic duct, extrahepatic biliary apparatus, gall bladder, Situs inversus

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ABSTRACT **Background and Objectives:** The extrahepatic biliary apparatus consists of the right and left hepatic ducts, common hepatic duct, gall bladder, cystic duct and common bile duct. The extrahepatic biliary apparatus is known to present several anatomical variations. The aim of the study is to detect and document variations of gall bladder and cystic duct.

Methods: A cadaveric study was conducted on human extrahepatic biliary apparatus in the Department of Anatomy, Government Medical College, Kozhikode, Kerala. The study was done in 50 human bodies – 35 adults and 15 full term still born fetuses. The liver and extrahepatic ducts were carefully studied, giving emphasis to the gall bladder and cystic duct. Observations were recorded and photographed.

Results : 1. In one case (2%) cystic duct was absent and the gall bladder was sessile

2. One gall bladder (2%) had a mesocystium and was a floating type

3. Cystic duct showed a spiral course and opened on the left side of common hepatic duct in one case (2%).

4. Hartmann's pouch was detected in four gall bladders (8%).

5. There was a case of situs inversus in one foetus (2%) where the liver and gall bladder were situated in the left hypochondrium.

Interpretation and Conclusions: The awareness of possibility of anatomical variations of the gall bladder and cystic duct is important during cholecystectomy, liver resections and transplantations to minimize iatrogenic injuries, morbidity and mortality in patients.

INTRODUCTION

The Extrahepatic Biliary Apparatus – Normal Anatomy[1]

The extrahepatic biliary apparatus consists of the right and left hepatic ducts, common hepatic duct, gall bladder, cystic duct and the common bile duct. Right and left hepatic ducts emerge from the right and left lobes of the liver. They join to form the common hepatic duct, which is about 3.5cm long. It unites with the cystic duct from the gall bladder to form the common bile duct.

The gall bladder is the reservoir of bile. It is pear shaped, 7-10cm long and 3cm broad at its widest part. It stores and concentrates bile. Gall bladder has a capacity of 30-50ml, has 3 parts, fundus, body and neck. The superior surface of gall bladder is non peritoneal and connected to the inferior surface of right lobe of liver by connective tissue. The inferior surface is covered with peritoneum.

The cystic duct is 3-4cm long. It begins at the neck of the gall bladder, passes downwards and to the left to join the common hepatic duct to form common bile duct. The cystic duct is a two way passage. It carries bile to the gall bladder. After concentration, bile is returned through the cystic duct to the common bile duct.

Common Bile Duct (CBD) is usually 7-8cm long and about 0.5-0.6cm in diameter. It descends in the free margin of lesser omentum and then passes behind the first part of the duodenum. On its way to the second part of duodenum, it passes posterior to the head of pancreas. The CBD is divided into 4 parts – supraduodenal, retroduodenal, infraduodenal and intraduodenal.CBD joins with the main pancreatic duct to form the hepatopancreatic ampulla, very close to the summit of the major duodenal papilla.

Development of liver and biliary apparatus:[2]

The liver develops from an endodermal hepatic bud that arises from the ventral aspect of the gut at the junction of foregut and midgut. This bud grows into the ventral mesogastrium and septum transversum. The hepatic bud enlarges and divides into a larger cranial part called the pars hepatica and a smaller caudal portion called the pars cystica. The pars hepatica divides into right and left parts, each of which forms one lobe of the liver. Pars cystica gives rise to the gall bladder. The part of the hepatic bud proximal to its division forms the bile duct.

Knowledge about the development of liver and biliary tract is helpful in understanding the congenital anomalies and anatomical variations.

Materials and Methods:

The study of the gross anatomy of extrahepatic biliary apparatus, with emphasis on the variations of the gall bladder and cystic duct, was conducted in the Department of Anatomy, Govt.Medical College, Kozhikode after getting consent from the Institutional Ethics Committee. 35 adult cadavers (24 males and 11 females) and 15 full term still born fetuses (all males) were utilized for the study. Bodies with cancer and adhesions between viscera were excluded.

The adult cadavers were meant for undergraduate and postgraduate studies. Abdomen was opened layer by layer after putting an incision from xiphoid process to pubic symphysis.

The fetuses were obtained from the Institute of Maternal and Child Health (IMCH) attached to the Govt. Medical College, Kozhikode, were embalmed by injecting formalin into fontanelle, body cavities and limbs. They were kept immersed in formalin. Later, at a convenient time, the abdomen of the fetuses were opened by a cruciate incision.

Viscera were carefully separated. Extrahepatic biliary apparatus was dissected, traced proximally and distally in all the 50 specimens. In some cases, part of the liver tissue surrounding the porta hepatis was removed to get a clear view of the structures entering and leaving the porta.

The observations were recorded. Specimens with variations of gall bladder and cystic duct were painted and photographs were taken.

RESULTS

The Gall Bladder:

The measurements of maximum length and width of gall bladder obtained in the present study are shown in **Table 1**

Table 1: Measurements of gall bladder

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Age and Sex	Maximum length in cm	Maximum width in cm
Adult male	6.7	3
Adult female	6.4	3.14
Foetus	2.8	0.8

Anomalies of gall bladder detected in the present study

a) Floating gall bladder:[3]

The gall bladder in an adult female was provided with a 'mesocystium' (mesentery) so that the gall bladder was hanging free from the undersurface of liver. There is a high risk of torsion and infarction in this type of gall bladder.

b) Hartmann's Pouch:[4]

A small recess projecting from the right side of the neck of the gall bladder, the Hartmann's pouch, was seen in 8 cases (16%) (Fig.1)

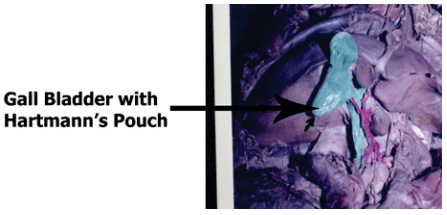
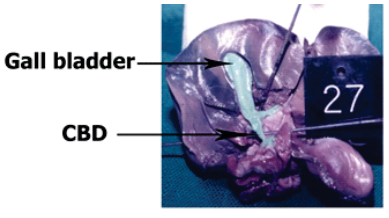


Figure.1

c) Sessile Gall Bladder:

In one male foetus, cystic duct was absent. The sessile gall bladder opened directly on the right side of common hepatic duct. This is a very rare variation. (Fig.2)



Sessile Gall Bladder

Figure.2

d) Duct of Luschka:[5,6,7]

An aberrant duct was running from the right hepatic duct to the superior part of the body of gall bladder(Fig.3). This duct did not communicate with the lumen of the gall bladder.The duct was 2.5cm long; it was broad (0.5cm) near its connection with the right hepatic duct. As it reached the wall of gall bladder, the duct became narrow, branched and merged with the coating of gall bladder. Blue ink injected into the duct using insulin needle and syringe did not enter the lumen of gall bladder. This type of accessory hepatic duct is known as the supravesicular type of Duct of Luschka.

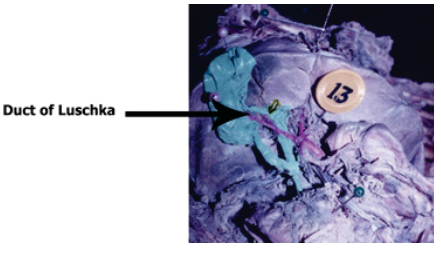
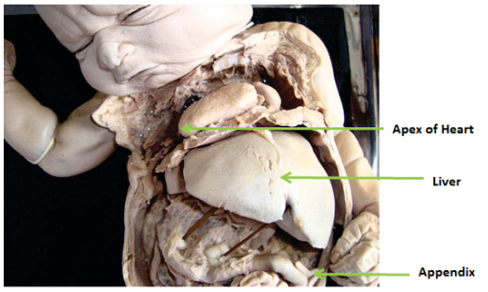


Figure.3

e) Gall bladder in left hypochondrium – A Case of SitusInversus:[8,9,10]

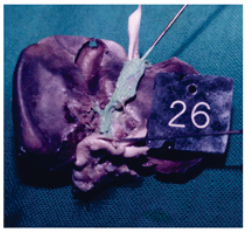
There was a case of situs inversus in one foetus (2%) where the liver and gall bladder were situated in the left hypochondrium (Fig.4).



Situs Inversus Totalis

Figure.4

Variations of the cystic duct: The cystic duct showed variations in measurements. Average length in adult males was 2.3cm, in adult females 1.9cm and in foetus, 0.7cm. In 47 specimens (94%, the cystic duct joined the common hepatic duct at an acute angle (angular). In one specimen (2%) it was parallel type in one specimen (2%) it was spiral and entered the common hepatic duct on its left side (Fig.5) Cystic duct was absent in one specimen (2%).



Anterior spirality of Cystic duct

Gall bladder mobilised from its fossa to display anterior spirality of its duct

Figure.5

DISCUSSION

Congenital anomalies and normal variants of biliary apparatus have significance during surgeries on liver, gall bladder and pancreas. Failure to recognize these anomalies may lead to inadvertent ligation and biliary leaks after surgery.[11]

Preoperative diagnosis of these anomalies by routine investigations is difficult. But, most of these can be recognized by radiologic evaluation.[12] Recent advances in MRI, MRCP and Multi-Detector (MD) or Helical CT Scan are helpful in recognizing such anomalies.[13]

ANOMALIES OF GALL BLADDER

a) Floating Gall Bladder:[3]

Floating gall bladder is an uncommon variation with clinical significance. This type of gall bladder is suspended by a peritoneal coat from the undersurface of liver. This type is seen in approximately 5% of routine autopsy. This 'mesentery' or meocystium may cover the entire length of the gall bladder creating a stable structure. Sometimes, it surrounds only the cystic duct creating a pendulous gall bladder.

Torsion of gall bladder may occur in people with this anomaly, which is a surgical emergency. Patients – usually elderly women – present with abrupt onset of severe right upper quadrant abdominal pain, nausea and vomiting. An infarcted gall bladder on a twisted pedicle will be seen during surgery.

In the present study, a floating gall bladder, completely covered by peritoneum was seen hanging from the undersurface of liver in an adult female. It was hanging about 2cm below the liver.

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Khamiso Altaf Hussain Talpur et al[14] have observed 2% variations of gall bladder. They have been buried gall bladder (1%), floating gall bladder (0.33%) and gall bladder with Phrygian cap (0.33%). Phrygian cap (folded fundus) is said to be the commonest congenital anomaly of gall bladder, but has no pathological significance.[15]It is seen in 2-6% of cholecystograms.[16] But, in the present study, no such gall bladders were detected.

Abnormal locations of gall bladder have been described such as intrahepatic, retrohepatic, gall bladder within the falciform ligament, retroduodenal and retropancreatic areas.[17] No such congenital anomalies were detected in the present study.

b) Hartmann's Pouch:

A small recess projecting from the right side of the neck of the gall bladder, the Hartmann's pouch, was seen in 8 cases (16%). There are two views regarding the Hartmann's pouch; it is said to be a normal feature. But Davies and Harding[4] are of the opinion that it is always a sequel of inflammation.

c) Sessile Gall Bladder:

In one male foetus, cystic duct was absent. The sessile gall bladder opened directly on the right side of common hepatic duct. This is a very rare variation.

Congenital absence of cystic duct:

Congenital absence of cystic duct is a rare anomaly that can cause bile duct injuries during cholecystectomy, which is the most common digestive tract surgery performed worldwide.[18]

Absence or shortening of cystic duct can be congenital or acquired. Patients with dense pericholecystic adhesions and/or gall stone impaction also show short cystic duct and these are said to be acquired absence of cystic duct. Sachin Patil, Sudhir et al observed a male: female ratio of 1:2.3.

In the present study, only one case of absent/short cystic duct was observed, in a male fetus.

d) Duct of Luschka:[5,6,7]

In the present study we observed a duct leading from right hepatic duct to the upper surface of gall bladder body. But it did not communicate with the cavity of gall bladder. In literature, this type of a duct is described as supravesicular type of accessory bile duct.

The term "duct of Luschka" is named after German Anatomist Hubert Von Luschka (1820-1875). Duct of Luschka is a type of accessory bile duct. These are small ducts that enter the gall bladder bed. They can arise directly from the liver, right hepatic duct or common hepatic duct. They may not always drain bile and sometimes can have blind distal ends.

The duct (or ducts) may be described by its location relative to the gall bladder as supravesicular (superior to the gall bladder body) or subvesicular (inferior to the gall bladder body). Although they may not drain any liver parenchyma, these ducts can be a source of bile leak or biliary peritonitis after cholecystectomy in both adults and children.

Anomalies of Cystic Duct

Recognition of the anatomical variations of cystic duct is essential during surgery, especially during cholecystectomy. Identification of the site of cystic duct, its course and angulation with the common hepatic duct makes the surgery more safe and decreases complications resulting from injury to the ducts. Accidental clipping of CBD or common hepatic duct can cause congestion and bile leakage and as a result leads to jaundice. This may necessitate re-exploration soon after surgery or a second operation at a later stage.[19]

Tamol Limthanakhom has reported 5 types of cystic ducts depending on their pathway before forming common bile duct as follows:

1) Angular type – cystic duct runs downwards, forms an angle with the common hepatic duct before joining the common hepatic duct.
2) Parallel type – cystic duct runs parallel to the common hepatic duct before joining with it.
3) Spiral type – cystic duct runs downwards and spiral around the common hepatic duct before joining it.
4) Short or absent type – cystic duct is extremely short or no cystic duct at all.
5) Replaced cystic duct – Abnormal cystic duct leading from gall bladder to the right hepatic duct.

A comparison of variations obtained in the present study and the variations observed by various authors are shown in **Table 2.**

Table 2: Different Patterns of Cystic Duct [in Percentage]

Sl. No.	Variation of cystic duct	Moosman DN 1951 n = 1000	Kune GA 1970 n = 1000	Limtha-nakhom [Khon Kaen] 2005 n= 96	PRESENT STUDY 2016 n = 50
1	Angular	75	75	79.2	94
2	Parallel	20	20	8.3	2
3	Spiral	5	5	6.3	2
4	Short or absent	0	0	5.2	2
5	Replaced cystic duct	0	0	1.04	0

The angular type is the most common in the studies conducted by LimthanakhomT ,Moosman DA[20] and Kune GA.[21] In our study also, the angular type of cystic duct was the commonest, but the percentage is more than that observed by the other authors.

Limthanakhom et al have reported a short or absent cystic duct; the incidence of short or absent type in the present study is less than the value reported by these authors.

A replaced cystic duct was not observed in the present study.

Limthanakhom has described the short or absent type, accessory duct and replaced duct as dangerous variations and has emphasized that special attention should be given during cholecystectomy, if these variations are recognized before and during surgery.

Khamiso Altaf Hussain Talpur et al[14] have reported 4.33% variations of cyst duct in their study, which includes parallel type (0.33%), short type (2.67%), long type (1%) and accessory cholecystohepatic duct (0.67%).

Congenital absence of cystic duct was detected in one case in the present study which is discussed under anomalies of gall bladder.

Patients with recurrent episodes of gall stone pancreatitis separated by brief intervals should raise the suspicion of a congenitally absent cystic duct.[19]Knowledge of this anomaly, its mode of presentation, and surgical approach can prevent inadvertent biliary injuries.

e) Gall bladder in left hypochondrium – A case of Situs Inversus Totalis:

In a full term, still born male fetus, this very rare phenomenon was detected. There was reversal of thoracic and abdominal viscera. Examination of the abdomen confirmed a left sided liver and gall bladder. The spleen, greater curvature of stomach , sigmoid colon were on the right side. Caecum and appendix were on the left side. Thorax showed dextrocardia , left lung had 3 lobes and right lung had two lobes. The liver was oriented in a mirror image of its normal anatomical position, the larger anatomical lobe lying on the left side and the smaller lobe crossed the midline. The gall bladder was

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situated on the inferior surface of the larger lobe.

The second part of duodenum and head of the pancreas were also situated on the left side.

Further dissection of biliary tract and pancreatic duct was not done because we decided to mount the fetus and keep it in the department museum.

Situs inversus is estimated to occur in 1 in 5000-20,000 births.It may be associated with cardiac, respiratory, gastrointestinal, hepatic, pancreatic, neurological and urological anomalies, some of which may be life threatening.[8,9,10]

Senthil Kumar and Giuseppe Fusai have reported a laparoscopic cholecystectomy in situs inversus totalis with left sided gall bladder. The patient, a 57 year old woman, presented with history of intermittent left upper quadrant pain radiating to the left scapular region. USG and MRI showed situs inversus and stones in the left sided gall bladder.

Though situs inversus on its own is not pathological and occasionally detected in an X-ray of chest or USG abdomen for some other symptoms, patients with liver and biliary diseases show differences in presentation and there may be difficulty in diagnosis. A careful planning and modification of surgical techniques also becomes necessary.

Patients with situs inversus , who are scheduled for cholecystectomy (or any other surgery) should be assessed preoperatively for cardiac or respiratory abnormalities.

CONCLUSION

The Anatomy of extra hepatic biliary apparatus is highly variable. Extrahepatic biliary system is said to have more anomalies in one cubic centimeter of the area around the cystic duct than any other region of the body.[22] The risk of iatrogenic injury and disastrous consequences such as leakage of ducts, biliary fistula, biloma, sepsis and repetitive episodes of cholangitis is high in surgeries like cholecystectomy, liver resection and liver transplantation when there are anatomical variations or congenital anomalies.

Preoperative assessment of biliary anatomy can be done using various imaging techniques. Detection and recognition of such anomalies can bring down the morbidity and mortality rates during hepatobiliary surgery.

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